Commonwealth of Kentucky
Department of Highways

Highway Materials Research Laboratory
132 Graham Avenue, Lexington 29, Kentucky

December 30, 1952

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TO: D. V. Terrell
Director of Research

A year ago the first of our formal reports on evaluations of traffic paint was presented to the Research Committee, and with it were ratings of paint which the Division of Traffic was considering for its needs in striping pavements throughout the state during 1952. The success of service-stripe evaluations as a means for qualifying paints for bidding invitations had been well established at that time, but results this year have confirmed it.

Because of this success, annual application of test stripes has become a routine procedure. The current stripes to qualify vendors for bidding on 1953 invitations were placed in August, and initial evaluations were made a few days ago. Such an early evaluation would be questionable if it were not for the fact that the stripes applied in 1951 were still quite usable after 16 months of service. Observations of those earlier stripes aided materially in substantiating some of the conclusions based on the stripes with less than 5-months service. The most encouraging point, however, is the fact that paint in the test stripes could remain in relatively good condition after 16 months of exposure.

Material pertaining to the evaluation in 1952 has been purposely kept brief in the attached report by A. C. Peed, Jr. This is so since detailed descriptions of all procedures were given in his report last year. Tabulations and photographs contain all the essential data pertinent to present needs. However, particular attention should be given to his recommendation that our long-standing Emergency Provision No. 11-R on "Missouri Type Yellow Traffic Paint" be superseded by an up-to-date specification on a dispersion resin type paint containing titanium pigment.

Examples of specifications which have been adopted by two other states are appended to this report for whatever benefit they may be to the Engineer of Specifications and the Specifications Committee. We will be glad to cooperate in the preparation of a revision if it is desired.

Another point warranting particular attention, and one which originated with the Research Committee meeting at which the first report was presented last year, is an unusually hardy but rapid-drying paint that would be suited to use on cross-walks in cities. Mr. Peed has noted some promise in the lacquer-type paint included in tests this year, but he also notes some limitations. I understand that a small quantity of this paint has been purchased on the strength of early observations of the test stripes, but I am not certain whether it has been applied or whether the Traffic Division has any results to report on its use.

As a final thing, I am taking this opportunity to record the fact that in the near future Mr. Peed will be terminating his employment with the Department. He has accepted a position with the Eastman Kodak Company, and this will be his last meeting with the Research Committee. I am certain that we are unanimous in our appreciation of his work with paints and several other projects in our research program, and we wish him well in his new employment.

Respectfully submitted,

L. E. Gregg

L. E. Gregg
Assistant Director of Research

LEG:ddc
Copies to: Research Committee Members
Mack Galbreath (3)

Commonwealth of Kentucky
Department of Highways

EVALUATION OF TRAFFIC PAINT IN 1952

by

A. C. Peed, Jr.
Research Engineer

December, 1952

Following the program of in-service transverse stripe evaluation coupled with laboratory study of traffic paint samples submitted by various manufacturers who propose to bid on the Department's paint requirements, field stripes were placed August 19, 1952. For this test stripes were placed in the same general location as that used the two previous years (U.S. 27 south of Lexington at the junction of the concrete and bituminous pavements). Gradings contained herein were made December 27, 1952, and thus represent a somewhat premature five-month evaluation. However, the set of stripes placed in 1951 were scrutinized since they had sixteen months of service, and those paints which appeared in good condition in both groups have been selected as the most desirable and are recommended. In the case of paints which were placed this year but were not previously tested, no discrimination was made except to note the evaluation as tentative and subject to change as more data become available.

Lacquer-Base Paint

Paints evaluated this year were, with but one exception, all of the premixed glass-bead reflectorized type since current Department policy is directed toward the exclusive use of this type. The one exception was a lacquer-base traffic paint which has been offered as a partial solution to the striping of city streets where extended service life would be an exceptional advantage and where traffic dictates that stripes dry as rapidly as possible in order to minimize the interference with high volume vehicular flow.

The lacquer-base non-reflectorized paint (Stripe No. 13 and No. 25) demonstrated very desirable drying properties for the above mentioned use. As a matter of fact, one stripe was placed without interruption to traffic and although a small amount of tracking was notable the stripe was not appreciably damaged. These drying characteristics, while invaluable for city striping, have the disadvantage of being too fast to allow external-bead reflectorization since the paint film is almost dried on the surface before the beads can be applied. Thus, most of the beads that are applied do not bind or else they are so loosely bound as to be quickly dislodged. Premixing was attempted and unfortunately resulted in clogging of the nozzle of the spray machine so that striping could not be continued. This may have been an accident, but it seems more likely that it is indicative of an undesirable property of the paint. In any event, this formulation seems worthy of additional study for the specific purpose of municipal use where its four to five minute drying time would prove invaluable.

Improved Dispersion Resin Type Paint

Another formulation type which was tested this year but which is not listed in the recommended group is an improved dispersion resin type paint, similar to that covered by the Department's "Missouri Emergency Type Traffic Paint" specification. The emergency specification was written at a time when titanium pigments were unobtainable and was designed as the best paint which could be manufactured under the severe procurement conditions then existing. Since pigments are now in much greater supply it is only proper that the specification should be altered to take advantage of the availability of better components. Other states which use dispersion resin formulations have altered their specifications along lines that are desirable. (See Appendix for current Missouri and Illinois specifications).

Stripes No. 5 and No. 6 in the 1952 test group are the Department's specification type, while stripe No. 7 is an altered dispersion resin paint conforming to the Missouri and Illinois Specifications. It can be seen that the altered formulation appears somewhat better than the one meeting Kentucky's specification, and it compares favorably with the proprietary paints although the performance is still slightly in favor of the non-specification mixes. In view of the promise shown by this change, it is recommended that the Specifications Committee consider the possibility of altering or amending the Department's current specification, and that samples procured under the revision be included in the testing program for 1953.

Ratings

Table 1 gives the identification for each of the stripes in the 1952 test series along with the grading of December 27, 1952. The recommended three in white and yellow respectively are marked with an asterisk. Appearances of the stripes at the time they were rated are illustrated in Fig. 2.

Table 2 gives the identification for the stripes in the 1951 test series along with their gradings on December 27, 1952. Their condition on that date is shown in Fig. 1. The sixteen-month evaluation of these stripes was given considerable weight in the recommendations due to the more clearly defined nature of the differences between stripes. The five-month service period covered in Table 1 is just beginning to show appreciable differences and thus where the distinctions were slight in the 1952 series, reference to the same paints in the 1951 series served as an aid in deciding which were the better.

The grading system used in the evaluation of the transverse stripes is identical to the one used last year which was:

0 - Useless, paint barely discernible if at all

1 - Poor, traces remain but not serviceable

2 - Fair, serviceable but dim

3 - Good, still serviceable but shows wear

4 - Excellent, fully serviceable

Laboratory Tests

Data from laboratory tests on the paint samples submitted in 1952 are listed in Table 3. It will be noted that some additional information has been recorded in the 1952 testing which was not given in the 1951 tabulation. Specifically, percentages of vehicle and pigment have been determined, by centrifuging, as a further aid to the identification of quantity purchases with the previously tested samples. It is to be noted here that the percentage pigment includes the reflectorizing beads since beads and pigment are practically inseparable once they are mixed.

The other set of new data is listed in Table 3 as "Consistency-Krebs Units." This information was obtained in the laboratory on each of the paints except those with the lacquer-base which, due to their high volatility, were deemed inadvisable to open in advance of the application date and two other samples which were received too late to be included in the laboratory work. Consistency data has come to be recognized as one of the better indications of spray-nozzle performance of traffic paints and is thus, of some value as a selection factor as well as a further clue in the identification of quantity purchases.

A Stormer Viscosimeter with paddle-type rotor was used in the consistency tests according to A.S.T.M. Designation: D 562-47. It has been found that for spray application of premixed paints consistency should be in the vicinity of 90 Krebs Units with a lower (thinness)

limit of 70 K.U. and an upper (thickness) limit of 125 K.U. The more viscous paints may be assumed to have either a slightly greater hiding power or a greater glass bead inclusion.

In the last column of Table 3, application rate information is listed. This was obtained in the same manner as in the 1951 testing by weighing a foot of stripe placed on a previously weighed piece of kraft paper. The attempt was made to place each stripe at as near to 16 gallons-per-mile as possible, but limitations of the individual paints and the spray machine prevented this in many cases. Hence, in many instances it was necessary to compromise with a rate as close to the optimum as was possible. In the majority of the cases, application rate was within, plus or minus, ten to fifteen percent of the desired rate.

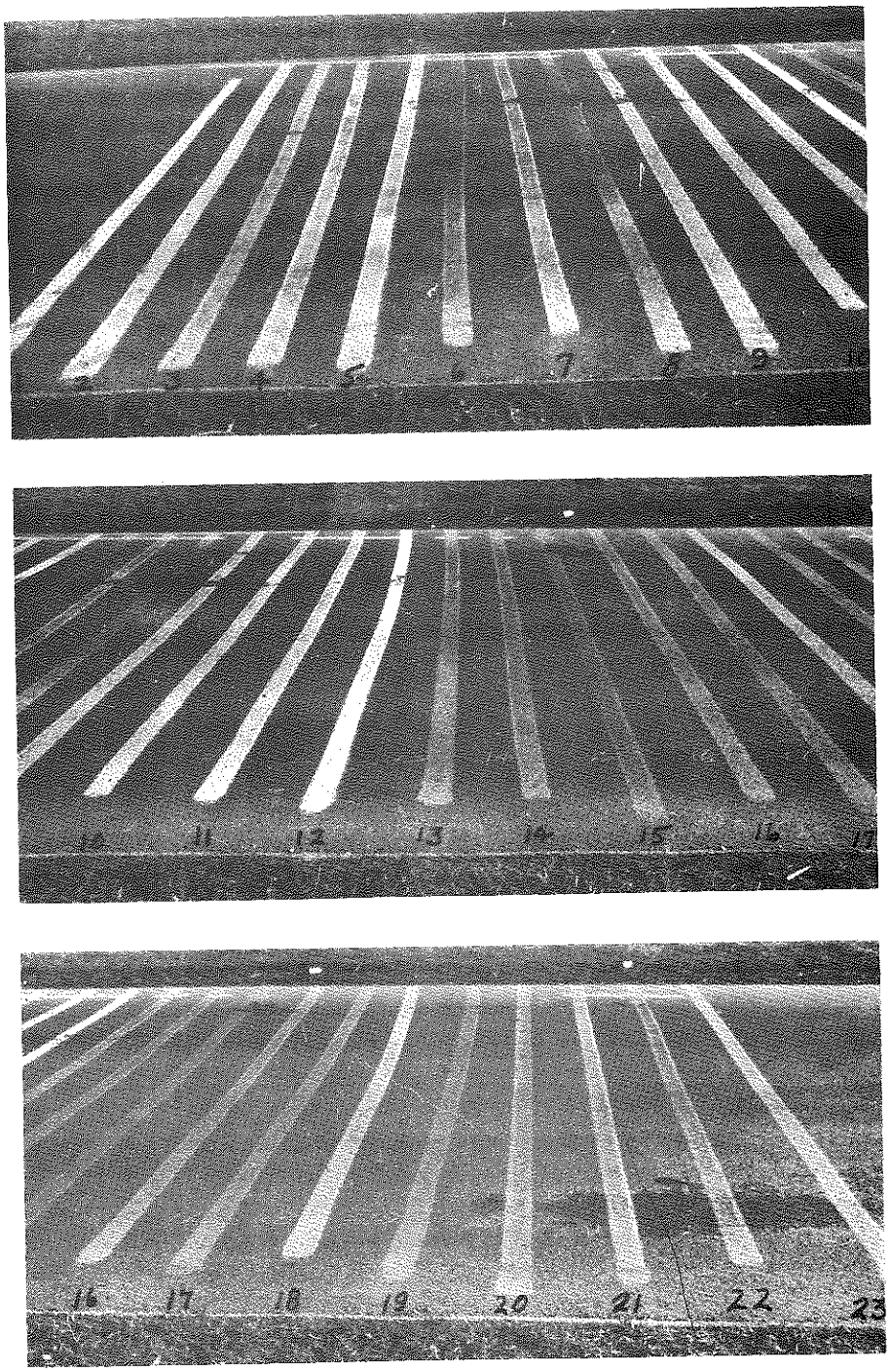

Fig. 1. Condition photographs of transverse stripes placed August 22, 1951. Photograph taken December 27, 1952, after 16 months service. Yellow stripes (Nos. 13 through 23) appear fainter than white stripes due to differential color sensitivity of the photographic film.

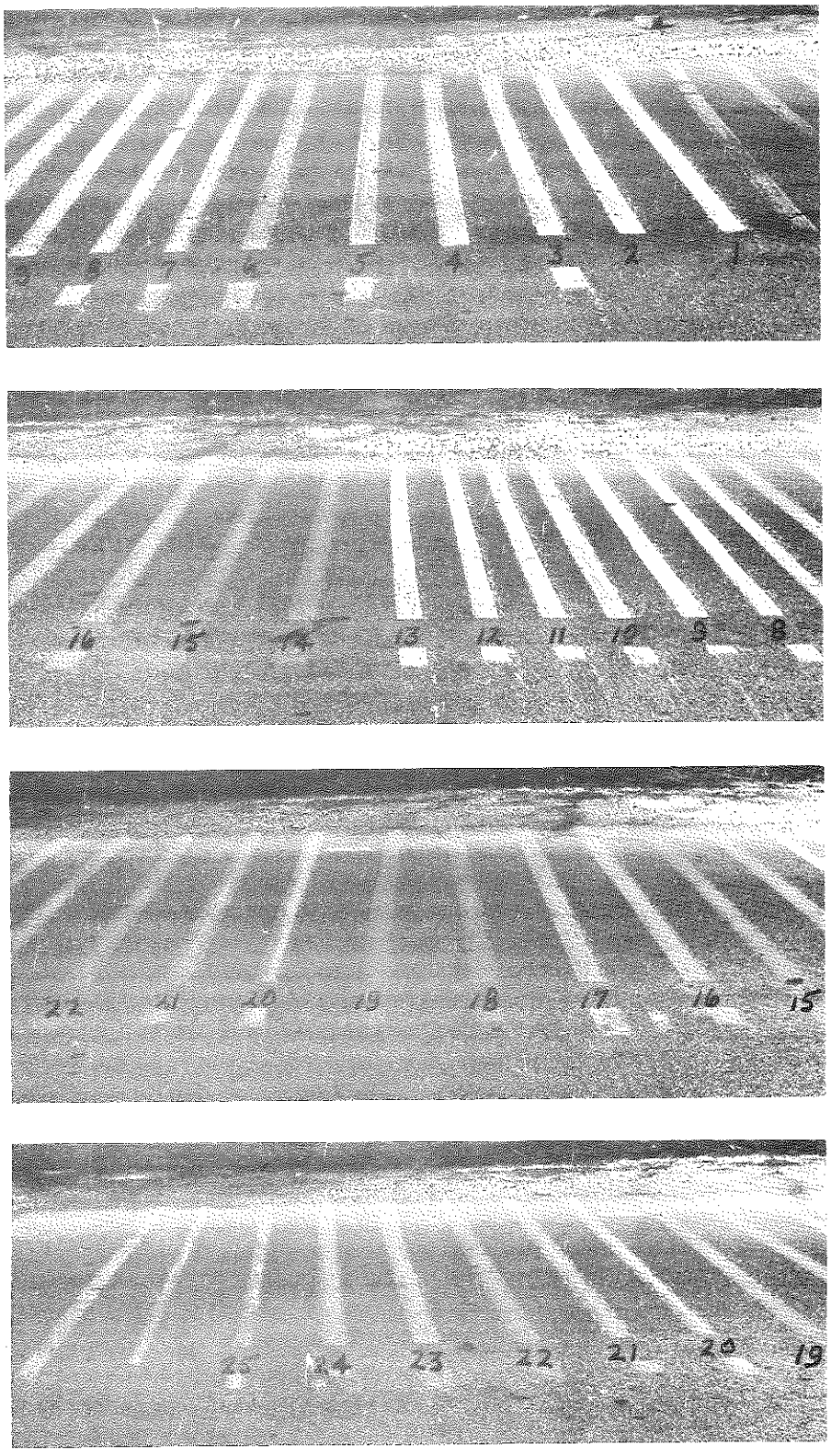

Fig. 2. Condition photographs of transverse stripes placed August 19, 1952. Photograph taken December 27, 1952, after four months and one week of service. Yellow stripes (Nos. 14 through 25) appear fainter than white stripes due to differential color sensitivity of the photographic film.

TABLE 1

EVALUATION OF 1952 STRIPES AFTER FOUR MONTHS SERVICE

Stripe Number	Designation	Color	Condition December 27, 1952
1	Gleem 35123A*	W	4
2	Gleem 35119A	W	3
3	Sherwin Williams C 97WA57	W	2
4	Bakelite EF1736 B#3290-90B	W	2
5	Celucoat B-144	W	1
6	Celucoat B-124	W	1
7	Celucoat C-125	W	2
8	Glidden P2370	W	3
9	Centerlite CL2060* SCA 8591	W	3
10	Prismo X7697*	W	3
11	Prismo X7698	W	2
12	Truscon 89500	W	2
13	Dupont 253-1 U6465550	W	2
14	Gleem 35125A	Y	3
15	Gleem 35128A	Y	3
16	Gleem 35127A*	Y	4
17	S&W C97YA41	Y	3
18	Celucoat B-150	Y	2
19	Celucoat B-85	Y	1
20	Glidden P2369	Y	2
21	Centerlite CL2061* SCA 8592	Y	3
22	Prismo X7705	Y	2
23	Prismo 7699*	Y	3
24	Prismo X7700	Y	2
25	Dupont 253-52422 U615141	Y	3

* Recommended for purchase

TABLE 2

EVALUATION OF 1951 STRIPES AFTER 16 MONTHS SERVICE

Stripe Number	Designation	Color	Condition December 27, 1952
1	Prismo Standard Lifeline	W	4
2	Gleem 25-466B	W	2
3	Enterprise 5786	W	2
4	Gleem 25-466A	W	3
5	Gleem 25-459	W	3
6	Celucoat B-83	W	0
7	Sherwin-Williams C97-WA55	W	1
8	Glidden 123	W	0
9	M.M.M. Centerlite C12060 (127-S)	W	2
10	Gleem 25-458A	W	3
11	Prismo Premix	W	3
12	Prismo Super Lifeline	W	4
13	Glidden 54A	Y	3
14	Sherwin Williams C 97 - YA 42	Y	2
15	Prismo Premix	Y	2
16	Gleem 24-465A	Y	3
17	M.M.M. Centerlite CL2061(81-5)	Y	3
18	Prismo Super Lifeline	Y	4
19	Enterprise 5798	Y	2
20	Prismo Standard Lifeline	Y	3
21	Gleem 25-463A	Y	3
22	Gleem 25-467	Y	2
23	Gleem 25-464	Y	3

TABLE 3

PHYSICAL PROPERTIES OF PREMIXED PAINTS IN 1952 TEST PROGRAM

Stripe No.	Designation	Specific Gravity	Percent Vehicle	Percent Pigment*	Percent Volatile	Drying Time	Consistency Krebs Units	Application Rate
1	Gleem 35123A	1.64	36.17	63.83	27.77	10 m.	81	11.05 g/mi.
2	Gleem 35119A	1.60	33.70	66.30	23.17	10 m.	82	11.15 g/mi.
3	S-W C97WA57	1.80	25.68	74.32	16.9	11 m.	99	12.41 g/mi.
4	Bakelite EF1736 B 3290-90B	1.43	41.10	58.90	16.7	10 m.	-	18.54 g/mi.
5	Celucoat B-144	1.62	32.18	67.82	13.04	13 m.	112	14.28 g/mi.
6	Celucoat B-124	1.63	33.01	66.99	15.92	12 m.	118	11.30 g/mi.
7	Celucoat C-125	1.80	26.04	73.96	11.8	8 m.	88	15.72 g/mi.
8	Glidden P2370	1.96	28.11	71.89	10.91	11 m.	85	16.60 g/mi.
9	Centerlite CL2060 SCA 8591	1.65	33.40	66.60	13.3	12 m.	88	18.47 g/mi.
10	Prismo X7697	1.61	37.70	62.30	17.41	10 m.	78	13.43 g/mi.
11	Prismo X7698	1.58	38.95	61.05	21.91	9 m.	78	12.27 g/mi.
12	Truscon 89500	1.90	-	-	16.6	7 m.	-	10.04 g/mi.
13	Dupont 253-1 U6465550	1.02	-	-	32.5	5 m.	-	10.89 g/mi.
14	Gleem 35125A	1.61	33.70	66.30	23.17	10 m.	82	15.07 g/mi.
15	Gleem 35128A	1.66	33.54	66.46	20.35	10 m.	81	15.71 g/mi.
16	Gleem 35127A	1.69	31.44	68.56	19.02	8 m.	76	19.71 g/mi.

TABLE 3 (Continued)

Stripe No.	Designation	Specific Gravity	Percent Vehicle	Percent Pigment*	Percent Volatile	Drying Time	Consistency Krebs Units	Application Rate
17	S-W C97YA41	1.76	30.86	69.14	15.92	12 m.	70	14.03 g/mi.
18	Celucoat B-150	1.62	33.33	66.67	14.05	11 m.	120	12.92 g/mi.
19	Celucoat B-85	1.63	33.96	66.04	14.29	12 m.	118	12.32 g/mi.
20	Glidden P2369	1.87	27.14	72.86	15.34	10 m.	72	15.60 g/mi.
21	Centerlite CL2061 SCA8592	1.68	33.33	66.67	14.06	13 m.	82	18.43 g/mi.
22	Prismo X7705	1.62	32.40	67.60	19.10	9 m.	77	19.92 g/mi.
23	Prismo X7699	1.63	36.36	63.64	19.55	10 m.	77	17.34 g/mi.
24	Prismo X7700	1.66	32.35	67.65	19.20	9 m.	81	14.37 g/mi.
25	Dupont 253-52422 U 615141	1.06	-	-	42.70	4 m.	-	8.95 g/mi.

*Includes reflectorizing glass beads

APPENDIX

State of Illinois
Department of Public Works and Buildings
Division of Highways
Springfield

SPECIFICATIONS FOR WHITE AND YELLOW TRAFFIC MARKING PAINTS (Dispersion Resin Type)

Serial Number: M 6 - 51

I. GENERAL REQUIREMENTS

1. SAMPLING AND TESTING. Unless otherwise provided, all materials shall be sampled and tested in accordance with the latest published standard methods of the American Society for Testing Materials, and revisions thereof, in effect on the date of the invitation for bids, where such standard methods exist. In case there are no A.S.T.M. Standards which apply, applicable standard methods of the American Association of State Highway Officials, or of the Federal Government, or of other recognized standardizing agencies shall be used.

2. INSPECTION. The right is reserved to inspect the paint either at the place of manufacture or after its arrival at destination. If inspected at the place of manufacture, the manufacturer shall furnish such facilities as may be required for collecting and forwarding samples of the ingredient materials and of the finished paint, and shall also furnish facilities for performing the inspection of the paint during the process of manufacture. Before manufacture of the paint is started, the ingredient materials shall be set aside at the manufacturer's plant and shall be sampled by an authorized representative of the Division of Highways. All materials represented by these samples shall be held until tests have been made and the materials found to comply with the requirements of the specifications. During the manufacturing operations, the Division of Highways' representative shall have free entry at all times to such parts of the plant as concern the manufacture of the paint. All tests will be made by and at the expense of the Division of Highways.

3. RATE OF PRODUCTION. Within thirty days after the date of the award of the purchase order, the manufacturer shall have assembled all ingredient materials in his plant and shall notify the Division of Highways that the materials are ready for inspection. Within one week after notification that the materials have been accepted, the manufacturer shall begin production, which shall proceed at a rate of not less than 600 gallons per working day and shall continue without interruption until the order has been completed.

4. PACKING. Unless otherwise directed, the paint shall be shipped in five-gallon nonreturnable containers meeting the following requirements: The containers shall be made of new metal not lighter than 24 gauge (0.0239");

the lids shall be of approximately the same diameter as the container; all lids shall be equipped with rubber gaskets; the containers shall have bails with handles; the containers and lids shall be either painted or galvanized, but for any one order shall be of the same color and design; and the containers shall meet the latest regulations of the Interstate Commerce Commission for shipping containers for these materials; the filled containers shall be acceptable to a railroad company for reshipment without crating, reconditioning, or repacking; and the containers shall be so designed that they may be stacked one upon the other in tiers at least four high.

Five gallons of paint shall be palced in each container. The paint shall be measured by volume, the unit of measure being a gallon of 231 cubic inches at 68°F.

Each container shall bear a label which shows the kind of paint contained therein, the manufacturer's name, and the purchase order number. The lot number of the paint and the month and year the paint is packaged shall be included either on the label or shall be stenciled on the side of the container.

II. INGREDIENT MATERIALS

5. CHROME YELLOW. The chrome yellow pigment shall be purchased in the dry form.

a) Manufacture. The dry pigment shall be a chemical precipitate consisting of normal or basic lead chromates or mixtures of these, with or without admixtures of other insoluble compounds of lead, but without any other admixtures.

b) Properties. The mass color and character of the tint formed by mixture with a white pigment shall be the same as and the strength not less than that of a sample furnished by the Department. The dry pigment shall conform to the following requirements:

Total matter soluble in water, not more than	0.5%
Total of all substances other than insoluble compounds of lead, not more than	3.0%
Organic colors or lakes	None
Moisture and other volatile matter, not more thar	1.0%
Coarse particles retained on a No. 325 sieve, not more than	1.0%

6. MAGNESIUM SILICATE. These specifications cover the pigment known commercially as magnesium silicate or asbestine. The magnesium silicate pigment shall be fibrous and finely ground and shall be purchased in the dry form.

a) Manufacture. It shall be a commercially pure fibrous and finely ground magnesium silicate, free from foreign material.

b) Properties. The color of the dry pigment shall be clear white, characteristic of this product and shall have the same characteristic physical structure as that of a sample furnished by the Department. The dry pigment shall meet the following requirements:

Insoluble in 6 N. hydrochloric acid, not less than	85.0%
Loss on ignition	4.0-7.0%
Moisture and other volatile matter, not more than	1.0%
Coarse particles (total residue retained on a No. 325 sieve), not more than	2.0%

7. TITANIUM DIOXIDE (Rutile Type). The titanium dioxide pigment shall be the rutile type and shall be purchased in the dry form.

a) Manufacture. The titanium dioxide pigment shall be composed of pure titanium dioxide and shall be free from adulterants.

b) Properties. The mass color and character of the tint formed by mixture with lampblack, shall be the same as and the strength not less than that of a sample furnished by the Department. The dry pigment shall meet the following requirements:

Titanium dioxide, not less than	94.0%
Moisture and other volatile matter, not more than	0.5%
Matter soluble in water, not more than	0.5%
Specific gravity	4.1 to 4.3
Coarse particles retained on a No. 325 sieve, not more than	0.2%

8. TITANIUM DIOXIDE-CALCIUM SULPHATE. These specifications cover the pigment know commercially as titanium-calcium pigment. The titanium-calcium pigment shall be purchased in the dry form.

a) Manufacture. The dry pigment shall consist of titanium dioxide and anhydrous calcium sulphate and shall be free from adulterants.

b) Properties. The mass color and character of the tint formed by mixture with lampblack, shall be the same as and the strength not less than that of a sample furnished by the Department. The dry pigment shall meet the following requirements:

Titanium dioxide, not less than	28.0%
Moisture and other volatile matter, not more than	0.5%
Anhydrous calcium sulphate, per cent of remainder, not less than	97.0
Coarse particles (total residue retained on a No. 325 sieve), not more than	0.2%

9. NORMAL BUTYL ALCOHOL. The normal butyl alcohol shall conform to the following requirements:

Specific gravity, 68°/68°F.	0.810 to 0.815
Color	Water White
Distillation range:	
Below 239°F.	None
Above 245°F.	None
Nonvolatile matter	Not more than 0.005 g. per 100 ml.
Odor	Mild, nonresidual
Water	Miscible without turbidity with 19 volumes of 60° A.P.I. gasoline at 68°F.
Acidity (free acid as acetic acid)	Not more than 0.03 per cent by weight, equivalent to 0.28 mg. of KOH per gram of sample

10. MODIFIED PHENOL FORMALDEHYDE RESIN. The modified phenol formaldehyde resin used in the manufacture of the varnish specified under Section 11 shall have the following properties:

Acid Number	10-20
Melting Point (R & B)	288°-330°F.
Specific Gravity	1.090-1.105
Oil Solubility	Suitable for varnish

11. VARNISH. The varnish shall have a 25 gallon oil length and shall be formulated with a modified phenol formaldehyde resin conforming to the requirements of Section 10. The non-volatile oil portion of the varnish shall be composed of not less than 75 per cent by weight of china wood oil. The balance of the oil portion is left to the discretion of the manufacturer with the exception that it shall not be fish oil. Suitable naphthenate driers consisting of lead, cobalt, and manganese, shall be incorporated to give the drying time specified. The thinner used in the manufacture of the varnish shall be V.M. and P. naphtha but a small quantity of mineral spirits will be permitted for initial thinning. The varnish shall meet the following requirements:

Appearance	Clear and transparent
Color (Hellige Comparator), not darker than	No. 18
Working properties	Varnish shall have good flowing and leveling properties.
Nonvolatile matter, not less than	50%
Toughness	It shall pass a 40% Kauri reduction test.
Viscosity (Gardner-Holdt)	From A to D at 77°F.
Set to touch, not more than	4 hours
Dry hard, not more than	8 hours
Cold Water resistance	A film of the varnish applied on a metal panel and air-dried for 48 hours, when submerged in cold water for 18 hours and then air-dried for 30 minutes shall show no whitening or dulling.

Hot Water resistance ..... A film of the varnish applied on a metal panel and air-dried for 48 hours, when submerged in boiling water for 15 minutes and then air dired for 30 minutes shall show no whitening or dulling.

12. DISPERSION RESIN. The dispersion resin shall be a highly polymerized oleoresinous material capable of being dispersed in naphtha or xylol or mixtures of naphtha and xylol, and drying entirely by solvent evaporation. The solid portion shall contain a high percentage of acetone insoluble material. The dispersion resin shall be thoroughly compatible with the varnish specified under Section 11 and shall have the following properties:

Solids	48 - 52%
Specific Gravity	0.88 - 0.92
Viscosity	150,000 - 350,000 centipoises
Viscosity, when tested in a mixture of 50% dispersion resin and 50% xylol by weight (Note 1)	800 - 1500 centipoises
Solvents	Aliphatic hydrocarbons
Thinners	Aromatic hydrocarbons

13. NAPHTHA SOLVENT. The naphtha solvent shall be a petroleum distillate commonly known as "rubber solvent" having the following characteristics:

A.P.I. Gravity at 60°F.	68 - 74
Initial boiling point	100° - 110°F.
End Point	Not over 300°F.
Color	Water White
Corrosion	It shall not blacken or corrode a clean metallic copper strip in 30 minutes at the boiling point of the naphtha.

III. MIXED PAINTS

14. MANUFACTURE. All ingredient materials shall be delivered in the original containers and shall be used without adulteration. The paint shall be ground thoroughly in an approved pebble mill or ball mill. The paints shall be prepared in such a manner that there will be no appreciable loss of volatile solvents or development of skins.

The finished paints when stored shall not thicken appreciably, skin over, liver, settle out appreciably or cake badly in the containers. The paints shall be free from dirt and other foreign matter and shall dry within the specified period to a good, tough, serviceable film. Sufficient C. P.

prussian blue paste shall be added to the white traffic marking paint to overcome any yellow tint in the paint. The traffic marking paints, when applied by spraying methods, to a bituminous pavement shall not be discolored due to the solvent action of the paint on the bituminous surface.

The quantities of pigments and vehicles used in formulating the paints shall be based on the average of the minimum and maximum composition limits given in the specifications. The manufacturer shall furnish to the Department the batch formula which will be used in manufacturing the paint.

15. WHITE TRAFFIC MARKING PAINT. The white traffic marking paint shall meet the following requirements:

a) Formula. The formula used in the manufacture of the white traffic paint shall be as follows:

Pigment (by weight):

Titanium Dioxide	9 - 11%
Titanium Dioxide - Calcium Sulphate	61 - 63%
Magnesium Silicate	26 - 28%
Aluminum Stearate	1.0%

Vehicle (by weight):

Varnish	42 - 44%
Dispersion Resin	28 - 30%
Normal Butyl Alcohol	3 - 5%
Naphtha Solvent	23 - 25%

Paint (by weight):

Pigment	42 - 45%
Vehicle	55 - 58%
Moisture, not more than	0.5%

b) Properties. The paint shall have the following properties:

Weight per gallon at 68°F., not less than ..... 10.0 pounds

Working properties ..... The paint shall have satisfactory spraying and hiding properties.

Drying time ..... When flowed on a tinned panel and set at an angle of 45 degrees, the paint shall dry hard and smooth in not more than 30 minutes at a temperature of 77°F. When applied to a pavement at the rate of 20 gallons per mile of 5-inch line the paint shall dry to nontracking in not more than 30 minutes.

Nonvolatile content of paint, not less than 62%

Viscosity, Stormer at 77°F. (Note 2) ..... 60 - 80 K.U.

Coarse particles and skins (total residue retained on a No. 325 sieve, based on pigment), not more than 1.0%

16. YELLOW TRAFFIC MARKING PAINT. The yellow traffic marking paint shall meet the following requirements:

a) Formula. The formula used in the manufacture of the yellow traffic marking paint shall be as follows:

Pigment (by weight):

Chrome Yellow	59 - 61%
Magnesium Silicate	38 - 40%
Aluminum Stearate	1.0%

Vehicle (by weight):

Varnish	42 - 44%
Dispersion Resin	28 - 30%
Normal Butyl Alcohol	3 - 5%
Naphtha Solvent	23 - 25%

Paint (by weight):

Pigment	39 - 42%
Vehicle	58 - 61%
Moisture, not more than	0.5%

b) Properties. The paint shall have the following properties:

Weight per gallon at 68°F., not less than ..... 10.0 pounds

Working properties ..... The paint shall have satisfactory spraying and hiding properties.

Color ..... The color of the dried film shall match the U.S. Public Roads Administration's 1939 standard yellow card for standard yellow for highway signs.

Drying time ..... When flowed on a tinned panel and set at an angle of 45 degrees, the paint shall dry hard and smooth in not more than 30 minutes at a temperature of 77°F. When

applied to a pavement at the rate of 20 gallons per mile of 5-inch line the paint shall dry to nontracking in not more than 30 minutes.

Nonvolatile content of paint, not less than	61%
Viscosity, Stormer at 77°F. (Note 2)	60 - 80 K.U.
Coarse particles and skins (total residue retained on a No. 325 sieve, based on pigment), not more than	1.0%

Note 1. Equivalent to viscosity (Gardner-Holdt) from U to Y.

Note 2. The abbreviation K.U. refers to Krebs Units based on the "Krebs' Stormer chart with interpolations."

Effective December 10, 1951
(This specification supersedes Serial Number: M 6-50 issued February 20, 1950)

Form LX-1

MISSOURI STATE HIGHWAY DEPARTMENT
BUREAU OF MAINTENANCE
Jefferson City, Mo.

February 20, 1950

SPECIFICATIONS FOR WHITE TRAFFIC MARKING PAINT

1. These specifications cover a ready-mixed white paint suitable for application on concrete and bituminous pavements.

2. The paint shall be homogeneous, well ground, shall not settle badly or cake in the container, and shall be readily broken up with a paddle to a smooth, uniform consistency. It shall be free from water, dirt and other foreign matter and shall dry within the specified period to a good, tough, serviceable film. Any paint which, prior to shipment, shall have livered or in any way hardened or thickened in the container, or in which the pigment shall have settled out so that it cannot be readily broken up with a paddle to a smooth uniform paint of good consistency shall be rejected. The paint shall be ground in a pebble mill. Sufficient prussian blue shall be added to overcome any yellow tint in the paint.

3. The manufacturer shall furnish the Engineer free access to all parts of the plant, and shall furnish every reasonable facility for sampling both the paint and the raw materials during the process of manufacture.

4. All materials used in manufacture shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

5. The ready-mixed paint shall be purchased by volume, one (1) gallon shall mean two hundred thirty-one (231) cubic inches at seventy-seven (77) degrees Fahrenheit.

6. All containers shall be approved by the Engineer as to type and weight.

7. Pigment Constituents

   (a) Titanium Dioxide (Rutile) shall comply with A.S.T.M. Specification D476-48 for Type II, Class I.

   (b) Titanium Calcium Pigment shall comply with A.S.T.M. Specification D476-48.

   (c) Magnesium Silicate shall be white, fibrous and finely ground and shall comply with A.S.T.M. Specification D605-42.

   (d) Aluminum Stearate shall comply with Navy Specification 52-A-12(a).

8. Vehicle Constituents

(a) Varnish shall have a 25 gallon oil length. It shall be formulated with a modified phenol formaldehyde resin which shall have the following properties:

Acid Number.....	12 - 18
Melting Point (R & B)	142 - 149°C.
Specific Gravity	1.095 - 1.105
Oil Solubility	Suitable for Varnish

The non-volatile oil portion of the varnish shall be composed of not less than seventy-five (75) per cent by weight of china wood oil, the balance of the oil portion to be left to the discretion of the manufacturer, except that the use of fish oil will not be permitted. Suitable naphthenate driers shall be incorporated to give the drying time specified. The thinner used in the manufacture of the varnish shall be V.M. and P. naphtha but a small quantity of mineral spirits will be permitted for initial thinning. The varnish shall be thoroughly compatible with the dispersion resin specified under paragraph 8(b) and shall meet the following requirements:

1. Shall be clear and transparent.

2. Shall set to touch within four (4) hours and dry hard within eight (8) hours.

3. Shall contain not less than fifty (50) per cent by wieght of non-volatile oils and gums.

4. For toughness shall pass a forty (40) per cent Kauri reduction test.

5. Shall have a viscosity of from A to D (Gardner-Holdt) at 25°C.

6. The dried film shall withstand cold water for eighteen (18) hours, and boiling water for fifteen (15) minutes without showing any whitening or dulling after removing from the water and drying at room temperature for two (2) hours. Separate films shall be used for each immersion.

(b) Dispersion Resin shall be a highly polymerized oleoresinous material capable of being dispersed in naphtha or xylol or mixtures of naphtha and xylol, and drying almost entirely by solvent evaporation. The solid portion shall contain a high percentage of acetone insoluble material. The dispersion resin shall have the following properties:

Solids	48 - 52%
Specific Gravity	0.88 - 0.93
Viscosity	800 - 1350 cps. when tested in a mixture of 50% xylol and 50% dispersion resin by weight.
Flash Point	Below 40°C.
Solvents	Aliphatic Hydrocarbons
Thinners	Aromatic Hydrocarbons

(c) Butyl Alcohol shall comply with A.S.T.M. Specification D304-45 for normal Butyl Alcohol.

(d) Naphtha Solvent shall be a petroleum distillate commonly known as "rubber solvent", having the following characteristics:

A.P.I. Gravity at 60°F.	68 - 74
Initial Boiling Point	100° - 120°F.
End Point	Not over 300°F.
Color	Not darker than 22 Saybolt.
Corrosion	It shall not blacken or corrode a clean metallic copper strip in thirty (30) minutes at the boiling point of the naphtha.

9. Pigment Formulation

	Per Cent by Weight
Rutile Titanium Dioxide	10.0
Titanium Calcium Pigment	62.0
Magnesium Silicate	27.0
Aluminum Stearate	1.0

10. Vehicle Formulation

	Per Cent by Weight
Varnish	43.0
Dispersion Resin	28.7
Butyl Alcohol	4.5
Naphtha Solvent	23.8

11. Mixed Paint

	Per Cent by Weight
Pigment	48.0 - 51.0
Vehicle	49.0 - 52.0

The consistency of the finished paint shall not exceed 80 seconds at 80°F. as measured on the #4 Ford Cup.

When flowed on a tinned panel and set at an angle of 45° the paint shall dry within thirty (30) minutes at a temperature of 70°F.

MISSOURI STATE HIGHWAY DEPARTMENT
BUREAU OF MAINTENANCE

MISSOURI STATE HIGHWAY DEPARTMENT
BUREAU OF MAINTENANCE
Jefferson City, Mo.

February 20, 1950

SPECIFICATIONS FOR YELLOW TRAFFIC MARKING PAINT

1. These specifications cover a ready-mixed yellow paint suitable for application on concrete and bituminous pavements.

2. The paint shall be homogeneous, well ground, shall not settle badly or cake in the container, and shall be readily broken up with a paddle to a smooth uniform consistency. It shall be free from water, dirt and other foreign matter and shall dry within the specified period to a good, tough, serviceable film. Any paint which prior to shipment, shall have livered or in any way hardened or thickened in the container, or in which the pigment shall have settled out so that it cannot be readily broken up with a paddle to a smooth uniform paint of good brushing consistency shall be rejected. The paint shall be ground in a pebble mill.

3. The color of the finished paint shall be standard Federal Yellow. No other pigments, lakes or tinting colors, other than specified shall be used, but two or more shades of chrome yellow may be used if necessary to obtain the specified standard color.

4. The manufacturer shall furnish the Engineer free access to all parts of the plant, and shall furnish every reasonable facility for sampling both the paint and the raw materials during the process of manufacture.

5. All materials used in manufacture shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

6. The ready-mixed paint shall be purchased by volume, one (1) gallon shall mean two hundred thirty-one (231) cubic inches at seventy-seven (77) degrees Fahrenheit.

7. All containers shall be approved by the Engineer as to type and weight.

8. Pigment Constituents

   (a) C.P. Chrome Yellow shall comply with A.S.T.M. Specification D211-47 for the dry form.

   (b) Magnesium Silicate shall be white, fibrous and finely ground and shall comply with A.S.T.M. Specification D605-42.

(c) Aluminum Stearate shall comply with Navy Specification 52-A-12(a).

9. Vehicle Constituents

(a) Varnish shall have a 25 gallon oil length. It shall be formulated with a modified phenol formaldehyde resin which shall have the following properties:

Acid Number	12 - 18
Melting Point (R & B)	142 - 149°C.
Specific Gravity	1.095 - 1.105
Oil Solubility	Suitable for Varnish

The non-volatile oil portion of the varnish shall be composed of not less than seventy-five (75) per cent by weight of china wood oil, the balance of the oil portion to be left to the discretion of the manufacturer, except that the use of fish oil will not be permitted. Suitable naphthenate driers shall be incorporated to give the drying time specified. The thinner used in the manufacture of the varnish shall be V.M. and P. naphtha but a small quantity of mineral spirits will be permitted for initial thinning. The varnish shall be thoroughly compatible with the dispersion resin specified under paragraph 9(b) and shall meet the following requirements.

1. Shall be clear and transparent.

2. Shall set to touch within four (4) hours and dry hard within eight (8) hours.

3. Shall contain not less than fifty (50) per cent by weight of non-volative oils and gums.

4. For toughness shall pass a forty (40) per cent Kauri reduction test.

5. Shall have a viscosity of from A to D (Gardner-Holdt) at 25°C.

6. The dried film shall withstand cold water for eighteen (18) hours and boiling water for fifteen (15) minutes without showing any whitening or dulling after removing from the water and drying at room temperature for two (2) hours. Separate films shall be used for each immersion.

(b) Dispersion Resin shall be a highly polymerized oleoresinous material capable of being dispersed in naphtha or xylol or mixtures of naphtha and xylol, and drying almost entirely by solvent evaporation. The solid portion shall contain a high percentage of acetone insoluble material. The dispersion resin shall have the following properties:

(Dispersion Resin - Con'd.)

Solids	48 - 52%
Specific Gravity	0.88 - 0.93
Viscosity	800 - 1350 cps. when tested in a mixture of 50% xylol and 50% dispersion resin by weight.
Flash Point	Below 40°C.
Solvents	Aliphatic Hydrocarbons
Thinners	Aromatic Hydrocarbons

(c) Butyl Alcohol shall comply with A.S.T.M. Specification D304-45 for normal Butyl Alcohol.

(d) Naphtha Solvent shall be a petroleum distillate commonly known as "rubber solvents", having the following characteristics:

A.P.I. Gravity at 60°F.	68 - 74
Initial Boiling Point	100° - 120°F.
End Point	Not over 300°F.
Color	Not darker than 22 Saybolt
Corrosion	It shall not blacken or corrode a clean metallic copper strip in thirty (30) minutes at the boiling point of the naphtha.

10. Pigment Formulation

	Per Cent by Weight
C.P. Chrome Yellow	60.0
Magnesium Silicate	39.0
Aluminum Stearate	1.0

11. Vehicle Formulation

	Per Cent by Weight
Varnish	43.0
Dispersion Resin	28.7
Butyl Alcohol	4.5
Naphtha Solvent	23.8

12. Mixed Paint

	Per Cent by Weight
Pigment	39.0 - 42.0
Vehicle	58.0 - 61.0

The consistency of the finished paint shall not exceed 80 seconds at 80°F. as measured on the #4 Ford Cup.

When flowed on a tinned panel and set at an angle of 45° the paint shall dry within thirty (30) minutes at a tmeperature of 70°F.

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